CONSTRUCTION SPECIFICATION

NV-33. CONCRETE CANAL LINING

1. SCOPE

The work shall consist of the installation of plain concrete linings in newly constructed or existing irrigation field ditches, canals and laterals to the elevations, grades and cross sections as shown on the drawings or as staked in the field.

2. MATERIALS

A. Portland cement shall conform to ASTM C 150 and shall be Type IP(MS), II, IIA, or V.

B. Fine aggregate shall conform to ASTM C 33 and be composed of clean, uncoated grains of material.

C. Coarse aggregates shall be gravel or crushed stone conforming to ASTM C 33 and be clean, hard, durable, and free from clay or coating of any character. Maximum size of coarse aggregate shall be 1½ inches.

D. Water shall be clean and free from injurious amounts of oil, salt, acid, alkali, organic matter, or other deleterious substances.

E. Air entraining agent shall conform to ASTM C 260.

F. Fiber Reinforcing shall be homopolymer polypropylene conforming to ASTM C 1116 for Type III Synthetic Fiber Reinforced Concrete.

G. Curing compound shall be a liquid membrane-forming compound suitable for spraying on the concrete surface. The curing compound shall meet the requirements of ASTM C 309 Type 2 (white pigmented).

3. FOUNDATION PREPARATION

The foundation area for all ditch embankments and/or ditch pads shall be cleared of all trees, weeds, sod, loose rock, or other materials not suitable for the subgrade. The maximum size of rock material greater than 2 inches shall be removed. All trees with root systems that are, or may become, a hazard to the ditch or canal lining shall be removed. The side slopes of stripped surfaces shall not be steeper than one (1) horizontal to one (1) vertical before placing earthfill.

4. DITCHPADS/EMBANKMENTS

Earthfill material shall be free of brush, roots, sod, large rocks, frozen soil or other materials not suitable for making compacted fills. Maximum size of rock shall not exceed a dimension grater than 2 inches.

The moisture content of earthfill materials shall be such that (1) bulking or displacement by hauling and compacting equipment does not occur; (2) material does not adhere to the treads and tracks of the equipment, and; (3) material can be worked and blended into a uniform mass.

The earthfill shall be placed in horizontal lifts with a maximum lift of 6 inches before compaction and after compaction the density of the earthfill is similar to adjacent undisturbed earth materials. Earthfill sections with a height of 2 feet or greater will be constructed using the compaction requirements of Construction Specification NV-23, Earthfill.

After the concrete lining and structures have been finished, fill materials shall be placed and compacted as required to complete the banks and berms in a smooth, workmanlike manner. All earthworks shall be finished to the grades and cross-sections shown on the drawings.

5. EXCAVATION

Excavation for ditch lining shall be to the neatlines of the specified cross section and finished with a smooth, firm surface. Over excavated areas shall be filled with concrete meeting the requirements of this specification or backfill with moist soil compacted to the density of the surrounding soil materials. No abrupt deviations from design grade or horizontal alignment shall be permitted.

Ripping, where necessary, shall be confined to the cross section of the ditch or canal.

6. DESIGN OF THE CONCRETE MIX

The concrete mix shall provide a minimum 28-day compressive strength of 3000 psi or greater. The mix shall contain not less than 5.5 sacks of cement per cubic yard. Not more than 6 gallons of water per sack of cement, including the moisture in the aggregates. Air entrainment shall range from 4% to 8%. Slump shall not exceed 3 inches.

The fine aggregate oven dry weight shall be 30-45 percent of the total oven dry weight of the combined aggregates.

The use of accelerators or antifreeze compounds shall not be allowed.

The Contractor shall be responsible for determining the design mix proportions and shall provide a copy of the mix for approval to the Technician at least 3 days prior to placing any concrete. A concrete batch ticket shall be supplied to the Technician at the time of placement. The minimum information to be included shall be the name of the supplier, size of load, time of loading, type and amount of cement, type and amount of admixtures, saturated surface dry weights of fine and coarse aggregates, mixing water at the plant and free water in aggregates.

If temperature and shrinkage reinforcement is specified, fiber reinforcing shall be added to the mix at the rate of 1.5 pounds per cubic yard.
Ready-mixed concrete shall be batched, mixed and transported in accordance with ASTM C 94.

7. PLACING CONCRETE

Concrete for linings shall be placed on moist, compacted surfaces free from debris, loose soil, mud, frozen ground or standing water. The foundation shall be moistened to a depth of at least ½ inch.

Slip forms and screeding equipment shall be operated as to place uniformly across the perimeter of the ditch or canal. Concrete linings shall have a smooth and uniform surface and shall be free of honeycombed or sandstreaked areas.

Concrete shall be delivered to the site and discharged into the slip forms within 1-1/2 hours after water is mixed with the cement and aggregates, or the cement with the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete, discharge of the concrete shall not exceed 45 minutes unless a set-retarding admixture is used or the mix is remaining workable.

Upon arrival at the job site, addition of water will be allowed to adjust the slump, provided such addition does not exceed the specified limits of the slump or maximum water content contained in the design mix. Final placement of the batch shall begin immediately after mixing of the added water is completed. No additional water shall be added to the mix after placement has begun.

Concrete shall be placed at air temperatures between 40^{o}F and 80^{o}F, unless special measures are taken to protect the concrete.

8. JOINTS

Contraction joints, at least ¼ inch wide, shall be cut transversely in the freshly placed concrete to a depth of 1/3 the thickness of the lining at an average spacing of not greater than 10 feet. Construction joints shall be butt type, formed square with the lining surface and at right angles to the centerline of the ditch. Contraction and construction joints shall be tooled so that the edges have a smooth finish.

A formed construction joint shall be made at the locations shown on the drawings, at the end of the day, or at any time when a cold joint would occur.

When shown on the plans, or otherwise specified, the contraction and construction joints shall be sealed with a cold application of a coal-tar modified polysulfide sealer, rubberized-asphalt mastic or other ready-mixed sealing compound that produces equivalent results. The sealing compound shall be applied in accordance with the manufacturer's recommendations.

9. CURING CONCRETE

Concrete shall be prevented from drying for a period of at least 7 days. Curing shall be accomplished by (1) covering with continuously moistened material; (2) impounding water in the lined ditch, or (3) use of an approved white pigmented curing compound in accordance with the manufacturer recommendations.

If conditions warrant, concrete shall be protected from freezing for a least 7 days after placement. Concrete damaged by freezing shall be considered as not meeting these specifications and must be removed and replaced.

10. BASIS OF ACCEPTANCE

The acceptability of the reinforced concrete shall be determined by inspection to check compliance with all the provisions of this specification, with respect to the drawings, and the minimum installation requirements.

Materials used shall be certified as meeting the requirements of this specification. The installing Contractor shall certify that the installation complies with the requirements of this specification. A written guarantee shall be furnished that protects the Owner against defective workmanship and materials for no less than one year.